The Mineral Wealth of India.

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THE MINERAL WEALTH OF INDIA.

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BY

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INDIAN ORDNANCE DEPARTMENT.

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BY

BAI SERENBAI, WIDOW OF THE LATE
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1893.

PREFACE.

The following pages do not pretend to deal fully with the question of the Mineral Wealth of India, but merely to touch on the wealth lying neglected at our feet, and the great future that lies before any one who exploits it on a large and scientific basis. Much has been written on this subject, but busy men have no time to read long treatises on special subjects, besides which they deal more fully with gold, silver and precious stones than with iron. From this pamphlet all mention of the former has been intentionally excluded. What India requires is a development of her iron ores, which are, in some places, extraordinarily rich. Therefore I have ventured to write this pamphlet in the hope that its very brevity and lightness may induce some to read it, who would otherwise avoid the subject. If they once do so, I can trust to the interesting nature of the subject for their further study. Should my feeble efforts induce a single capitalist or a single high official to look seriously into the question, I shall be more than repaid.

COLLINGWOOD TOWNSEND.

Bombay, *Xmas Eve, 1890.*

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THE MINERAL WEALTH OF INDIA.

CHAPTER I.

LOCAL IRON ORES.

No one is a prophet in his own country ; the armourers of Damascus sent to India for their steel, but India must needs get even its commonest iron from Europe. If a country were responsible like an individual for its wasted talents, India would have a heavy charge to meet in this respect. Endowed more richly in iron ores than almost any country in the world, she has, in a commerical sense, no iron industry at all. Had one-tenth of the trouble and money lavished on gold mining been devoted to scientific iron-smelting, the result would have been worthy of the country and remunerative to its promoters. There are two branches of the iron industry that might be locally developed ; first, the actual extraction of metal from local ores, which is the great need of industrial India, if she is to take a leading place among the manufacturing nations of the world ; and, secondly, the working up of the pig iron into its various forms of malleable metal. The development of local ores is one of the great duties we owe to India, failing which, any other attempt to deal with the metal can only result in half-measures. We occasionally read and hear

half-hearted laments that India does not utilize her ore, and the fault is always laid on the distance the fuel is from the mines. This is not correct in very many instances, as we shall presently see, but where these difficulties do exist, can we conscientiously say that any determined effort has been made on scientific lines to meet them? Nature never intended the Salem ore-beds containing thousands of millions of tons of the finest ore in the world to remain unexploited and useless to mankind. How long and how often must our great native capitalists be told that it is their duty, and would be their profit, to develop the dormant manufacturing resources of their great country? The first who wake up to the fact that a great fortune is waiting for any one who will attack the ironstone in a scientific manner will not only reap profits for themselves, but find employment for thousands of their poorer brethren, for the industrial effects of a great foundry are very far reaching. It is not in one or two places only that iron is to be found in remunerative quantities, but in a score. Let us look for a moment at the most productive of all, the Raniganj group in Bengal, where iron, coal, limestone for flux, and fireclay for the furnaces are all found together. The iron field lies between the two great coal fields of Raniganj and Barakur, and is as conveniently situated as if placed for the purpose of iron-smelting. We are fully aware that the Bengal Iron Company, formed in 1874, was closed as a failure in 1879; but that proves absolutely nothing except the want of capital and energy, and possibly scientific knowledge, especially as it is now working once more. Only about £100,000 were subscribed altogether, which was far too little for such an enterprise. The original Company had to make large payments on account of land, which were quite unexpected. Government refused to aid them in any

way to raise money, so they had to pay heavy interest for the money they did obtain; and though Government helped to the extent of giving large orders for castings, the works had to be stopped. It is said that their manufacturing details were open to great improvement, but all those errors would be avoided by a company opening on a sound and scientific basis. The ore cost only eight annas per ton at the furnaces, which is cheap enough to give promise of large profits. The two sources of flux available at Raniganj consist of a 12-foot thick bed of dense limestone near the top of the Raniganj rocks, and the bed of the same in crystalline rocks to the south of the above-named. Excellent fire-clay, which has been well tested, is found in a carbonaceous under-clay obtained in the Raniganj coal field, so every material that could be required for successful iron working is to be found there.

I have dwelt upon the Raniganj field, because it is the most complete of all, and has been tried in a half-hearted sort of way; but it is far from being the only field in India, or even containing the best ore (though of ironstone ores, it has about the best quality). In the Wardha Valley all three materials are found in sufficient proximity for working; the iron ore at Pipalgaon being excellent compact crystalline hœmatite, while the Vindhyan limestone is pre-eminently good as a flux. There are several beds besides those of Pipalgaon, but this is most likely to be first worked, being nearest to the Warora Coal Mines. The Warora coal, however, as it stands, is considered unsuitable for foundry work from the small percentage of carbon and the enormous quantity of mineral ash it contains. Taking English coal, we find that Lignite has 66 per cent. of carbon and $2\frac{1}{4}$ per cent. of ash, while Bituminous, Wigan, and Anthracite coal contain $78\frac{1}{2}$, 80, and $90\frac{1}{4}$ per cent. of carbon, and 1, $2\frac{3}{4}$

and 1½ per cent. of ash, respectively. Warora coal contains only 45½ per cent. of carbon, and 14 per cent. of mineral ash. This want of carbon in Indian coal is the great difficulty foundries will have to contend with, for, without carbon, it is almost impossible to get up the great heats required for successful castings. In England, Lignite is avoided as far as possible for furnace work on account of its inferiority in carbon, from which it can be easily seen that Warora coal falls a long way short of what is considered necessary. Certain seams of coal, however, at Pisgaon (in the Wardha Valley) show 65 per cent. of carbon ; and if all other conditions were fulfilled this would be enough. The average analysis of Raniganj coal gives only about 53 per cent. of carbon ; and it may be wondered why this would not militate against iron works in that district also. It would to a great extent, were not many of the Raniganj seams nearly as rich as those of Kahabari (Hazaribagh), which touch 78 per cent. of carbon. This coal could also be made available at the Raniganj iron beds at low cost, its value at the pit's mouth being less than three rupees a ton. It is the best smelting coal in India. The conditions required for a smelting furnace, where ore is reduced, and a foundry, where castings are made from pig iron, are quite distinct. In extracting iron from the ore we *must* use the fuel obtainable on the spot, for economical reasons ; but when once we have obtained the pigs of cast iron, carriage for a moderately short distance, so as to obtain the best possible fuel, would not add greatly to the cost. Thus it would be quite feasible to have smelting furnances on the Raniganj iron bed, and foundries in connection with them at Kahabari, should the coal of the latter place be found to give better castings.

Raniganj and the Wardha Valley have been fully dealt with, because I want to see local iron a practical success

instead of a theoretical dream; and smelting under ordinary European conditions would be more likely to succeed in these centres. There are, however, very many other places where successful furnances might be erected. In Cutch there is iron ore in considerable quantities; but the local coal is too slaty to be of any use in furnaces, and the petroleum that is supposed to exist there has not yet been sufficiently developed to rank commercially as fuel. The future metal industry of Cutch will probably be aluminum in which it is rich. The Southern iron fields are so rich in ore that it would pay, we believe, to work them with charcoal, more especially, if the secondary processes of converting the pig iron locally obtained into wrought iron and steel were carried on at the same time. This means a very large undertaking and a heavy capital, but large concessions in Salem and Beypore would undoubtedly prove remunerative. In the first half of this century the "Indian Steel, Iron and Chrome" Company made large quantities of pig iron at Porto Novo in South Arcot, using Salem ore for the purpose. The iron produced was said to be especially excellent for the production of steel, and at a meeting held at Sheffield in 1859, it was declared for that purpose superior to Swedish iron. It is to its "Swedish" tendencies, its great purity, and the low heats at which it can be worked that Salem iron should look for its future. The Company was wound up, though the chairman of the Sheffield meeting considered India would become the largest source of iron for Sheffield; and one home manufacturer had actually purchased 1,000 tons of Indian pig for making railway tyres. A large quantity of Indian iron was used in the Menai Bridge and in the Britannia Tubular Bridge, showing that it was well appreciated at home. Large charcoal rights would have to be obtained, but they would be nothing

to the jungle fires that burn almost unchecked, and superiority of charcoal iron would render it worth the extra cost. Iron smelting in Southern India should have for its object the production of a very high class of iron only, for which it should endeavour to get a name, while Raniganj and the Wardha Valley should aim at producing the more ordinary qualities at a low cost. It would certainly be worth while to take the question of producing "wootz" on a large scale into consideration. If it paid a Persian trader to make periodical visits from Ispahan to Nirmal in the Subah Berar for the sole purpose of obtaining this iron for the Persian armourers, it would probably pay to export it to England. The iron is found in a very pure state in fine grains among a kind of mica-schist. The treatment of the ore was local and peculiar ; two qualities of iron obtained from magnetic iron, sand, and laterite, respectively, were blended in the steel crucibles. Very hard steel cakes, called by the natives "wootz," were thus produced, the heat to which they were subjected being exceptionally high. I have touched upon four distinct places in which iron might be produced from local ore under different conditions ; it is an industry only waiting for skill and capital to develop it. Let Government step in, and start the development of local enterprise by enquiring into the feasibility of establishing one or more foundries for developing iron ore, more especially that of Salem. "It is against the policy of Government to interfere with private enterprise." True ; but where there is no private enterprise to interfere with, it is not only wisdom but almost a duty for the State to start the required works when they will not only pay but will develop the wealth of the country enormously. State help and State direction is required in India when new lines of industry have to be opened up, and if given freely, the cost would soon be recouped.

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CHAPTER II.

THE VALUE OF ENGLISH SKILL.

If speculating on "what might have been" was anything but a profitless task, one might well be tempted to speculate on what might have been if the temperature of the Indian climate was, by any cause, reduced by twenty degrees, or even if such a change now took place. This is not quite so absurd as might be supposed when we consider that Siberia was once tropical and England a mere ice-floe. If India had a climate in which Englishmen would work out of doors, if it had a climate like Cashmere for instance, or like Australia, the development of its soil would be a far easier matter. The mere agricultural development would find occupation for thousands of people, as there are miles and miles of land on each side of the Indus that, if properly watered, would produce two crops of grain a year, or, at least, one of grain and one of other produce. Look at the fertility of the tiny station of Edwardesabad on the Derajat frontier ; the natives speak of it as "the garden," and though that is an exaggeration, it is beautifully green compared with its surroundings. You ride through eighty miles of desert, unrelieved by a blade of grass, and covered with glittering sand, and you come suddenly into the midst of fertile fields and beautiful grassy gardens, you hear the rippling of little water-courses on every side, and you feel that you have entered a cooler and entirely different

region, and yet the ground varies in no way from that you have left; it is exactly the same, but *it has been watered*. Irrigation of an elaborate kind, which brings a rill into every field, has long been practised by the natives of Edwardesabad, without any help from Englishmen (in the *details* of irrigation the natives are our masters), and simply by this aid the desert can be turned into a garden. For scores of miles along the Indus a belt fifty miles wide consists of the best corn-growing soil in the world covered with a six inch film of sand. Of course, this belt is interspersed with rocky clumps and ridges which it would be impossible to cultivate, but there are millions of acres only awaiting proper irrigation, as is shown by the patches of green which, here and there, show where a more than usually laborious husbandman has dug a well and watered his little plot of ground by sheer hard work. If the climate were only a little cooler, a colony of English settlers would soon grow as much wheat as they could sell and get three crops of hay off the rest of the land, which, well pressed by hydraulic machinery, would be gladly bought both by Government and by private individuals. The particular tract of country we have mentioned is only one out of many that would be infinitely developed if only European settlers could live and work, for India will produce everything if properly exploited, and if the modes of cultivation are studied scientifically. But this we cannot hope for as yet, though we may regret that so much good land is wasted, while other and poorer lands are cropped till they almost cease to bear.

But though the country as an agricultural preserve would benefit enormously if colonists could settle, how much more would the mineral produce be increased. When we consider the vast mineral wealth in Burmah and parts

of Madras, for instance, that only requires the enterprise and energy of English colonists to bring it to the surface, we cannot but feel the deepest regret that this solution is impossible. But something at least might be done by English capital if properly and conscientiously laid out to develop this wealth. I am not referring to diamond fields or gold mines, for it is still doubtful whether these will pay on a commercial scale, though there is undoubtedly plenty of both lying snugly hidden away to reward the plucky and persevering miner.

The metal that would yield the best results is iron, the one necessity of modern civilization which is found in large quantities both in Burmah and Southern India, notably at Chindwin and Salem, and found in a state that it is not difficult to reduce, for the ore at Salem is beautifully soft, better in some respects than the best Swedish iron, and if properly worked up, could be turned out of a very tip-top quality indeed, quite equal to the best English brands, and probably rivalling even the world-famed Lowmoor iron in its qualities. The quality of the metal is beyond dispute, though there are difficulties in the way that we shall deal with later on. The value to India of locally produced iron can hardly be over-estimated if she is to make any real advance and to take a place among the great nations of the world, and act the part which she should act in deciding the destinies of the nations. To begin with, her coinage is depreciated, and though this difficulty will, we hope, be soon done away with by aid of more enlightened views as to the true science of currencies, yet we must be prepared to meet the question on the spot. Every bar of iron that now comes out to India costs not only its real price, but a fictitious price due to exchange, and to forfeit that and not to try and avoid it is unworthy of English enterprise.

But even apart from this question of exchange, which is a serious one, why should India not only have to pay for the carriage of all her iron from England, but have to take just what she can get, *i.e.*, what England can spare her, when she has the very finest kinds of metal at her own doors, nay within her own domains—iron such as no nation in the world can excel even if they can equal it. The purity of Indian steel is beginning to be recognized in the home markets, even though its costly method of production makes its price very high, and the amount of it in the market is very small. Here we have only a small amount of metal and a small proof of the excellency of the quality, but it is a proof, and one that cannot be questioned, that the metal is excellent. Modern machinery, modern science directed by European skill could do much, and could convert what is at present a small and struggling industry for a few families into an industry supporting its tens of thousands, and pouring out its iron as a civilizing influence, not only over the whole of India, but also to China and even Australia. There is a vast and magnificent future before the Indian iron trade, a future that would stagger men if only they could realize it, but the energy and capital are wanting. Indian iron will one day command the market of the world. Why will India sleep and not awake to clutch the chances of greatness and profit that lie in her own lands? Why will she turn her mind to petty ends when the greatness of her future is a thing to be ensured by herself? We do not in the least look down on political or other aims. Far from it; but we feel sure that the great curse of India is her poverty and the inelasticity of the revenue, which great evils can only be cured by increased internal wealth. If that wealth lies, as all the evidence goes to prove it does, buried in her soil, the best

thing that can possibly happen to her is that it should be unearthed and devoted to the purposes for which it was created. But if anything is done in the matter it must be thoroughly done, or great failure will result. It is useless merely to extract the iron from the ore and then to go and say, "Our work is done ; here is the pig iron." If anything of that sort is attempted, the result will not pay half the cost of the experiment, for the pig iron will have to go back to Europe to be worked, and then to come out again when worked up, and the double freight would completely take the gilt off the ginger-bread. To develop Indian iron properly we must have all the necessary plant on the spot—the puddling furnaces, the rolling mills, the steam hammers, and all the thousand and one appliances that go to make up a foundry and iron factory—able to turn out finished bars and even finished iron work complete from the ore.

That such a proposal is a gigantic one and means nothing less than the construction of four or five large works at once is very true, but the mass of factories so constructed would not be one-third the size of some of the greatest English firms, such as the Elswick Ordnance Company or Krupp's Works at Essen, and it is very far from being an impossibility or even a great stretch of imagination. A little faith in the result, which can be ensured by a thorough analysis of samples taken from the fields, and a little speculation of an honest kind, would set at rest this question and not only confer a great boon upon India, but enrich the men who went into it.

One of the great difficulties in the way of thoroughly developing the Salem fields is the distance they are away from coal, but this distance is not so great, but that a light coal tramway laid down *ad hoc* would pay a really large firm consuming its hundreds of tons of coal a day. Besides,

has the neighbourhood of the coal mines been so thoroughly and *scientifically* explored for coal that the dictum of no coal should be accepted as final? Coal is nearly always found near iron, and there appears to be no reason why Salem should be an exception to the rule. The Chindwin valley is said to produce coal as well as iron; if this is true, a large factory could be established there without difficulty, the more so that the enormous forests render the use of charcoal, so beneficial to iron in its semi-manufactured state, quite feasible and cheap. Even where coal cannot be economically brought to the spot where the iron lies, there is no absolute necessity for giving up the attempt to start iron works, for there are other ways of killing a dog than hanging him, and coal, in its solid form, is not an absolute necessity for iron. The new gas furnaces and gas cupolas show us that ore can be reduced to the pig by gas alone, and it would be no great expense to convert coal into gas at the coal mine, and then to run it through a hundred miles or so of piping to the iron fields, and use it there. Other methods and materials may be resorted to, which will be dealt with in the chapter on fuel. But the chief things wanted to develop the iron industries of India are money and experienced skill, neither of which shall we get until either some skilled capitalist is attracted to the East with a view of developing, not its gold and jewels, but its iron, *or*—and this is the real solution—the natives of India, or a few of them, take real interest in these matters. We see how native enterprise has developed the cotton industry of Bombay, and made it what it is—an industry the greatest in all India. This is due to the fact that the natives have realized the value of cotton and also the processes of manufacture, and are devoting themselves to its development. Let them devote themselves to the study of iron with equal

zeal for five or ten years and then see what great results will arise. Let five or six of our most intelligent native youths, the sons and nephews of our great capitalists, be sent by their relatives to Europe to study the iron industries as they now go to study law and medicine. Let them be not too proud to learn in the proper way, *viz.*, as workmen, and not at first as masters, and much will be done. It is an old story but a true one, that India can be best developed by her own people, provided the people will study the right way.

CHAPTER III.

LOCAL MANUFACTURE OF WROUGHT IRON.

Next to the local production of iron ores the development of the iron manufacturing industries is interesting if only as the sole means of developing local ores. It possesses, however, a separate interest, in the fact that a considerable iron industry already exists in India for working up imported material, and this is capable of great extension under reasonable encouragement from Government. Attention has recently been called to the way in which Government refuse to recognize the manufacture of iron work in India from imported iron as a local industry, on the ground that the iron is not locally produced—an untenable argument which would make the Lancashire cotton mills other than a local British industry, on the ground that the raw cotton was imported. Leaving that question aside, however, let us consider how iron manufacturing industries in India could be developed. Labour being cheap out here, and native blacksmiths capable of a high training, it is manifestly unwise to pay more for English labour, *i.e.*, for English finished goods, than is absolutely necessary. Therefore, every development of iron factories in India should be welcomed and given a helping hand. Sir James Kitson, President of the Iron and Steel Institute, in his opening address at New York said: "The world must have iron and steel, and that nation is the wisest who

consumes the most." India would do well to take that lesson to heart, for as yet she has taken no steps in this direction, but rather makes the path of her iron masters as hard as possible, caring little apparently for the encouragement of the local industry, provided she can satisfy the red-tape, &c., of her home officials. Iron works started to deal only with imported pig would have, we believe, a fine future before them. They must be located near to a coal field, so as to command a large supply of cheap fuel, and also near a railway junction, on a navigable river, or in some easily accessible spot. Probably some place on the Hoogly would be best for the first experiment, for pig iron, being excellent ballast, can be taken to Calcutta as cheaply as to Bombay and the additional cost of floating it up the river would be very slight. Moreover, coal can be procured cheaply, as well as limestone and fireclay, the first being obtainable retail at Rs. 5 a ton, while limestone could be procured at about the same price, and fire-bricks at Rs. 2-8 per hundred, and if taken in the large quantities required for such works, probably very much cheaper. If the attempt was made, with any capital behind it, possibly a better way would be to establish two factories, one in a wooded district where timber facilities were considerable, and charcoal could be easily procured, for the conversion of cast into wrought iron ; and the other wherever the facilities mentioned above existed for the further manipulation and rolling of the "blooms" into serviceable shapes and sizes. If the work was carried out on a large scale, the "refining" of the iron and the furnaces for converting bar iron into steel might well be placed in a charcoal country, their products being transported to the factory at a coal centre for further manipulation.

If such a scheme is to succeed, it is all important that the first results should be good, and with that object in

view I would strongly recommend that only the best qualities of iron be dealt with. Take the best pig (which is just as cheap to export as the worst) and carefully refine it on charcoal refining hearths. Excellent charcoal can be cheaply obtained with a little care, and the metal is immensely improved by its action. Do not let an attempt be made to produce every kind and quality of iron at the first opening of the works, but rather devote immense care and attention to the preparation of *one* first-class brand. Let nothing but really first-class iron be made at the works for some years ; let this iron bear a special brand, *and do not allow a single inferior bar to go out at any cost.* Gradually the brand thus carefully watched will acquire a name, will be enquired for in the market, and command a high price. We are, in India, far too ready to seek for immediate profit, to look for dividends the first year, without troubling ourselves about the quality of the article produced : nothing more fatal to the success of a new iron industry could well be imagined. So greatly are brands, and brands alone, sought after that the most unscrupulous forgeries are carried out with impunity, and "Swedish" iron especially, which, when pure, is soft and easily worked up at comparatively low heats, is put on the Indian market in large quantities. Yet when much of this so-called "Swedish" iron, which bears the marks of and is cut like real Swedish, comes to be tested, it proves utter rubbish, of the very commonest British quality, useless for anything but railings or similar work, where little manipulation under the hammer is required. These frauds do not, however, detract from the value of the brands, and it is towards establishing a "brand" that the first attention should be paid. It has been argued that we cannot make iron as cheaply in India as in England ; but though this

may possibly be true of those cheaper grades, it would not be the case, I believe, with first-class iron. Labour and charcoal are both cheaper in India than in England, and on these depends to an enormous extent the *quality* of the wrought iron produced. The Bessemer process might be introduced with advantage (the Bessemer "iron" process I am alluding to, not that for the preparation of steel) and be made to pay, because of the fact that the pig iron could be prepared in the centre factory, thereby saving carriage. Only very high grades of pig are suitable, however, to this process, as it is impossible to remove the phosphorus and sulphur from inferior qualities, as is done by the puddling process. It is mentioned merely to show the various possible ramifications of a local industry, not as necessarily advocating its use, though so cheap a process for ordinary metal must not be lost sight of. By the erection of local works and rolling mills for the conversion of "cast" into "wrought" iron, we avoid the necessity for keeping enormous stocks of every kind involving great expense for suitable store-rooms, besides sinking a great deal of money in bars without any hope of an early return. Pig iron, on the contrary, can be stacked in the open without appreciable loss, and, given suitable refining hearths and puddling furnaces with a fairly complete set of "rolls," it would be possible to turn out bars of the size and dimensions required by the demands of the market from time to time, thereby sinking comparatively little money in stock, for the pig iron will suit any size of bar, and placing the material on the market as required.

In time of war the existence of works of this nature might be of incalculable value, as abolishing all risks of capture at sea, and the consequent want of some essential

kind of iron at a critical moment. Under the present conditions of the iron trade, any kind of bar that is a little out of the common run, *i.e.*, any size or shape not commonly demanded, can only be obtained by import from England. Would this always be possible in time of war, and, if possible, would the price be other than extortionate to cover risk of capture? Certainly not, and it is to avoid these difficulties we urge the establishment of large works to deal with cast iron and work it up through all the necessary stages till it becomes the finished wrought iron bar.

The development of local ores, however, offers the best and most important field to the iron master, for it is by this alone that he can ever hope to compete with the European trade on a scale similar to that of the great English firms, Above all, the manufacture of wrought iron bars from local pig iron should be carried out on the highest lines, seeking only to develop the best qualities of the metal. Magnificent ores are available, as has already been shown in a previous chapter, and it would be a comparatively easy matter to start some really high class brands of wrought iron with a little trouble. Care must, however, be taken at every stage to admit nothing that would in any way detract from the quality of the outturn. It would be well worth working not only the refining, but also the puddling processes with charcoal instead of coke, and to take the necessary heats for the subsequent "fagotting" of the blooms, and for rolling the bars with charcoal only. By this means a grade of bar iron could, it is believed, be produced, which would considerably astonish the iron market. The Porto-Novo factory, which was working in South Arcot in 1859, turned out pig-iron of a really high grade; and at a meeting held at Sheffield in that year, to discuss the value of Indian iron, it was held that, "after various

trials and experiments, that iron, as produced for file purposes from Indian pig, was *superior to any other in England*, and that it had been proved to be superior to ordinary marks of Swedish iron for steel purposes. One manufacturer had bought over a thousand tons of Indian pig for railway tyres. The chairman stated that he had been the first to make steel from Indian pig, and from that time it had been steadily making its way." I have already pointed out the historic value of the Hyderabad ores, from which the wootz, used in making the famous Damascus sword blades, was obtained. With such proofs of the excellence of the iron obtainable in India before us, can we doubt that a local industry to work it up with charcoal would prove a very great success, and be the means of producing bars that could compete with the best Swedish brands, and even with such English qualities as Lowmoor or Bowling? "Keep to the best possible grades until a name is established" should be the motto of all Indian iron industries for some years to come. The celebrated iron pillar at the Kutub at Delhi has long been a puzzle to antiquarians; it is of wrought iron, and weighs some six tons—a weight which could not have been manipulated in England some years ago. The question is, how could this enormous mass have been forged when there is no tradition of local works dealing with such large masses? A very possible explanation is that it was cast, being a kind of mild steel of the quality recently introduced into England, and so extensively used. That the iron workers of the Malabar Coast understand something about producing malleable castings is undoubted, for, while carrying out some experiments in connection with a patent for melting wrought iron scrap, I found a Malabar blacksmith who thoroughly understood how to deal with the

metal obtained, though it required *very* careful handling ; it is quite possible that this knowledge may have spread to Northern India, and even have been elaborated there. Be this as it may, the iron industry is one of the oldest in India, wootz having been exported over 2,000 years ago, and whoever revives the industry will find a far greater fortune within reach than will come to the seeker after gold and jewels, besides being a real benefactor to the country by helping her towards an improved civilization.

CHAPTER IV.

THE BASER METALS.

Though less interesting than iron, in that they do not affect the greatness of the country so much, the baser metals of India are of especial interest from the antiquity of their development, and the fact that to a large proportion of the inhabitants they have, practically, been the only useful metals known. The noble metals, as gold and silver are called, have been used almost entirely for ornament and coinage. Platinum, really a precious metal, more valuable even than gold, is generally found with the latter, though rejected by the native gold-washers of the Indus Valley as *safed sona* and valueless. It has never yet been discovered in large quantities in India, and, except in the Indus Valley and the Kolar Gold Fields, we have no evidence of the discovery of more than traces of the metal. Mercury, though thoroughly understood in this country, does not seem to have been discovered in any large quantities, though the persistent rumour that asserts its plentiful presence in the Andaman Islands can hardly be without some basis. The probable explanation may be in a discovery of cinnabar in the Little Andaman, which has, as yet, never been thoroughly searched, as its rocks of the early tertiary period interspersed with volcanic "faults" closely assimilated to those of the great mercury beds of California. The author of "Hamilton's East Indies" saw in 1694 a native

who had brought much mercury from the Little Andaman (of which he was a native, stolen in his youth and partially civilized) to the Nicobars. It has been discovered in Cannanore in spots of pure metal in a bed of laterite, but never seems to have been much developed. Pure mercury is brought from Afghanistan, said to be obtained from Pir Kisree, some 250 miles beyond Kandahar. The trade, however, has never reached any size. COPPER is by far the most important and valuable of the baser metals, as it has also, perhaps, been longest known in Asia. There are mines now unused that appear to be of great antiquity, showing in this as in many other things how greatly the people of India have deteriorated in scientific knowledge. Where formerly the extraction and smelting of copper ores was carried out on a large scale, we now see petty workings that yield before every reverse of nature. The largest copper workings in India are those of the Singhbhum district, extending as they do for over 76 miles from Midnapore to Lohardugga. It is believed that the Jains started mining in this district over two thousand years ago, since which they have never quite ceased work. In 1857 an attempt to work the ore on a larger scale was made by the formation of a company, operating to the extent of some 1,200 cwt. per mensem. This company was wound up in 1859, chiefly because of the heavy royalty of nearly Rs. 10,000 a year paid to the Rajas owning the land and the wasteful importation of European workmen, which swamped so many Indian mining operations in the early part of the century. Careful and scientific working should make these fields very profitable for a company. Even in 1859 it was found that the rough ore, when quarried and hauled to the foundry, cost from Rs. 22 to Rs. 23 per 100 cwts. of raw ore. Taking this all round as producing 6 per

cent. of pure copper (some of it produced as much as 35 per cent., while other samples less than one per cent.), we get the cost of the copper before smelting as Rs. 4 per cwt. allowing a margin. To extract the ore should not cost more than Rs. 6 per cwt., so that it could be produced at Rs. 10 per cwt., including all labour and material. If on the top of this we place about 200 per cent. for extravagant plant, wages, &c., we naturally crush the industry, while a royalty on the top of all simply extinguishes it.

It ought to be easy enough to keep the cost of supervision, interest on machinery, royalty, &c., down below 100 per cent., in which case a good profit might be expected if the line of rail passed within reasonable distance, as it will now probably do. The "Indian Copper Mining Company" was formed in 1831 to work the Nellore Mines, but it collapsed after a short time, probably from causes similar to those that broke up the Singhbhum Company, for economical working seems hardly to have been understood sixty years ago. In the Goomacunda Valley, in the Karnaul district, there exists a deserted copper mine, so old that the very legend of its workers has been lost to the people living there. In the Hazaribagh district there are also deserted copper mines and large mounds of copper slag, showing that the ore was smelted on the spot. Ore is found here, which would probably repay any attempt at systematic working. The chief secrets of success in Indian mining seems to be, 1st, working on a scientific basis so as to waste neither metal nor labour; and, 2nd, utilizing native labour wherever possible, and obtaining European foremen who can teach their men the practical use of their tools.

The Khetri Mines, as they are called, including those of Kulhari and Singhana, are still worked, and of great

antiquity. They resemble nothing so much as a rabbit-warren, the galleries, such as they are, winding about after the metal and being little bigger than absolutely required to admit the bodies of the miners. Large quantities of blue vitriol and copperas are extracted from the refuse of the mines, and these "refuse products" are at least as valuable as the actual ore itself as at present extracted ; but this is becoming a not uncommon feature of modern manufacturing industries. Flooding is the great danger of the Kulhari galleries, as the only means of clearing them from water consists of a string of men with *ghurras*. The Singhana Mine must have paid well in former days, for the miners paid fourteen thousand rupees a year to the Khetri Rajah as the rent of the mines, in addition to one-sixth of the copper mined. It is thought that copper mining in the Hazara district would be profitable ; but the question of carriage would be a serious one, though the ore is extremely rich, being in this respect far superior to that found in Kumaon. The Nepalese do a good deal of copper mining in a small way, their ore yielding about $4\frac{1}{2}$ per cent. of copper. The Hazara ores are said to have yielded from 60 to 90 per cent. of copper from the picked ore, but I feel utterly disinclined to accept these figures. They probably were obtained, if obtained at all, from small and excessively rich selected pieces, and are by no means a fair sample of the whole. Possibly by "copper" is meant "regulus" which *in itself* only yields 50 per cent. of copper. Even the smallest pieces of ore could not yield 90 per cent. of pure metal. Next to copper its common alloys, zinc and tin, are the most interesting of the baser metals. ZINC is only found to any extent in Oodeypore, where the Jawar Mines were formerly worked on a large scale, and yielded a yearly revenue of nearly $2\frac{1}{4}$ lakhs of

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rupees. At present no extensive zinc workings exist in India, though possibly the indications of the metal at both Sirmur and Tavoy might yield profitable results to scientific development. TIN, on the contrary, is found on a large scale in several places, though the fact that the natives of India have used brass universally for centuries seems to point to the presence of zinc in some form or another possibly imported. Tin occurs chiefly as a di-oxide, the tin stone containing as much as from 75 to 80 per cent. of metallic tin. In 1867 the native iron smelters of Raniganj smelted some of the tin stone, supposing it to be iron ore, and when they saw white metal, mistook it to be silver. Burmah is the greatest Indian source of tin. It is worked by the Karens in the hills near the Salwin, and sold by them in Tounghu. In the Tenasserim Division tin stone is very plentiful, every stream bed near Maleewoon in Mergui yielding the metal when washed. Dr. Oldham states that the main source of all the Tenasserim tin is the granite range separating that province from Siam, where "it exists as an essential ingredient of the mass of rock, occurring disseminated through the granite in small crystals, and being similarly arranged to the quartz and felspar. * * * The degradation of this granite by weathering through an enormous period of time has supplied the sand which is now so abundantly impregnated with stream tin."

At Mergui it used to be worked in the very gardens of the town, and in the Thawbawleck River there have been extensive stream washings for years, the fine sand being sorted out with a cane shovel that acts like a large sieve, and finally washed in wooden dishes, in which the tin sinks by its own weight on the water being revolved. The only European attempt to work Burmese tin on a considerable

scale was made between 1873 and 1877, when Messrs. Steel and Sons leased the township of Maleewoon, where they not only washed the stream tin, but opened out veins of ore in the hills. During the cold weather of 1874-75 some seven tons of metal and fourteen tons of cleaned, picked ore were exported. The works were, however, closed in 1877, they having cost more than they yielded. It is worthy of note, however, that since the European workers failed, the Chinese have found the mines remunerative, and are still at work there, though they pay a ground rent and a royalty of 5 per cent. This was, however, less than that paid by the European firm (7 per cent.), while the Chinese paid a rent of only £272 per annum, against £1,000 demanded from Messrs. Steel & Co. From a manufacturing point of view, tin naturally suggests lead, and no mining industry, except iron, shows such a falling off as that of the working of lead mines. Galena, the sulphide of LEAD, is common in many parts of India, but Cuddapah and Karnaul are probably richest in the ore. In Cuddapah at the village of Jungumrazpilly, close to the Nallamallay Hills, the old lead workings are conspicuous. To quote Mr. Oldham again: "The old and now deserted lead workings are at the south end of the low ridge. The pits or galleries have been excavated between beds of dark grey siliceous limestone, which is impregnated with strings of white and dull blue quartz. Granular sulphide of lead is disseminated in very small quantities through the blue quartz. In the white quartz there are faint traces of copper. The old workings are to a great extent filled up with excavated fragments of rock, and are now overgrown with jungle." One group is said to have contained over fifty mines. A sample of ore from these regions was analysed in 1879, and yielded 78 per cent. of lead and

22 oz. 7 cwt. of silver to the ton of lead. Both these and the Karnual Mines would probably repay scientific exploitation handsomely. Three analyses of ore from the latter yielded, respectively, 374 ounces, 175 ounces, and 165 ounces of silver to the ton, which would render them well worth working. In Bengal galena has been found in the Sonthal Pergunnahs and also in Bhagalpore. An analysis of ore found in the latter district showed 78 per cent. of lead and 103 ounces of silver to the ton. Hazaribagh, so rich in metals, yields also galena, and in 1880 a company was formed in Bombay, called the "Imperial Silver Lead Mining Company, Limited," to work this district ; but it came to nothing. Ajmere, Sirmur, and Tenasserim would also yield profitable results. Truly, the mineral wealth of India has been sadly neglected.

CHAPTER V.

THE MINERALS USEFUL IN IRON SMELTING.

Next to iron and coal the minerals of most importance to anyone interested in the development of the Indian manufacturing industries are those incidentally useful in the working of iron. Foremost among these stands LIMESTONE, which is essential if we wish to obtain iron from the ore on a commercial scale. Fortunately this mineral is found in great quantities at or near the probable iron mines of the future. They vary, however, very greatly in quality, many beds containing a heavy proportion of worthless ingredients. Carbonate of lime is the chemical required for foundry work, and that limestone is the best which contains the greatest quantity. The proportions vary immensely, as will be seen from an examination of samples from different beds. Some calcareous tufa in the Darjeeling range showed 98½ per cent. of pure carbonate of lime and only 1½ per cent. of foreign matters, of which all but an infinitesimal fraction consisted of magnesia. On the other hand, samples taken from the Pachete rocks near the Raniganj coal fields showed on analysis only 45 per cent. of calcium carbonate, the balance being chiefly made up of 11½ per cent. of magnesium carbonate and *over* 39 *per cent. of insoluble matter*. It is this high percentage of insoluble matter which is the great objection to the use of the Raniganj limestone, otherwise the beds of Hansa-

pathar, which shows 83½ per cent. of calcium chloride, would do well enough if the insoluble matter amounting to some 16 per cent. could be eliminated. In the Wardha Valley, another great iron field, limestone is found containing from 94 to 97 per cent. of carbonate of lime and only 2 per cent. of insoluble matter,—an advantage that would tell heavily in favour of any works for reducing iron ore established in that district. The best limestone is found in the Vindhyan range, and could be cheaply transported to any works that would probably be erected. There is no limestone actually available at Salem, though the iron fields there are the richest in India ; but it occurs in many places in the Madras Presidency, sometimes with only 2 per cent. of impurities. So valuable, however, are the Salem iron fields that it would pay to transport whatever limestone might be necessary for works erected there, especially as it can be obtained near the line of rail. Nature has been prolific in her stores of all required to develop the iron ores of India, but we seem unable to realize the wealth lying at our feet.

Next to limestone, FIRECLAY is one of the most necessary products, for imported bricks and clay are very costly. The best fireclays are found in England, as in India, in the beds underlying the coal seams. Excellent bricks have been made from the Raniganj clays, and have successfully passed very severe tests in the Calcutta Mint. The cost of firebricks made from them is, moreover, only Rs. 2-8 per hundred—about a quarter of those obtained from England. When the Bengal Iron Works Company was in existence, it used bricks made of local clay with good results. Good fireclay is also found in the Madras Presidency and in the Wardha Valley. I have, however, grave doubts as to the value of Indian firebricks, as

hitherto made, for the inner layer of iron furnaces. They do extremely well for all parts of the furnace, if fortified with a lining of English bricks. This, however, appears to be necessary where great or prolonged heats are obtained. It is quite possible, however, that an increased demand might develop some better method of treating the local clays, so that they would make bricks suitable even for furnace linings. That they can be used in all other positions is an enormous saving, and the cost of importing English bricks for lining only would not be excessive, and should not stand in the way of a foundry. Graphite is another substance of great value in a foundry, as the cost of imported crucibles is very great.

The drawback of local GRAPHITE is the high percentage of impurities. Good specimens have been found in Travancore, which have been worked up into crucibles suitable for all but excessive heats. It is more than probable that if a proper system of manufacturing crucibles under pressure was started in Madras, the results would prove of great value if annealed—a precaution which should be taken in this country even with imported crucibles—and it would perhaps be worth trying. Considering the high position held by Ceylon graphite in the commercial world, it would probably be better to import this material as the cost of transport would not be great, and Ceylon graphite could be made into crucibles, as well in India as in England, if proper machinery was set up. It is a valuable industry and well worthy of encouragement, though utterly overlooked up to now. A demand would create a supply, and a steady and scientific attempt to develop local ores would soon create this demand. Everything depends on a start being made in the direction of developing local iron ores ; that once done, all the rest will follow. It is useless

to try and make graphite crucibles in India without hydraulic pressure and the proper machinery, since crucibles thus made crumble too much in the fire to be able to stand great heats, though useful enough for small brass castings of a few pounds only. It is so important to obtain good local crucibles for economy in working, even if they be made from Ceylon graphite, that it is strange the matter has never been taken up before. Possibly the comparatively small demand has prevented any attempt in this direction, but if large local works were established, their demand would be considerable, and should be met accordingly. MANGANESE is also procurable in India, though no large quantities are known to exist in any one place :— "The commonest ores are manganite or grey oxide ; wad or earthy protoxide ; pyroluxite, or the black peroxide ; psilomelane, a combination of the oxide of baryta ; hausmanite, or peroxide occurring with other ores of the metal and braunite, or binoxide in combination with iron peroxide, silica, and magnesia." The latter is found in Vizagapatam and Bimlipatam, the beds in the former district yielding sufficient for working iron on a considerable scale even as already discovered, while careful search may reveal larger beds. Psilomelane and pyroluxite are found in the Central Provinces, where they have long been used in glass-making, but has not been worked to any great extent. These specimens contain more oxygen than those in the Madras Presidency. Braunite is found in the Nagpore district, and was reported by the Executive Engineer of the Kanhand district as lying in a bed a quarter of a mile long and ten feet thick. Thus we see that sufficient manganese is already known to exist in India to provide for the necessities of any iron industry likely to be developed in twenty years. Even if no more beds were discovered, the cost of import-

ing sufficient spiegel-eisen should not be so great as to affect the iron industry materially. Considering the fact that manganese deposits frequently occur in laterite, it is more than probable that a careful search among the laterite rocks of the Eastern and Western Ghauts in the Rajmahal Hills and in Orissa would result in the discovery of extensive manganese beds ; but no such search could well be carried out with the necessary thoroughness until the demand for manganese that must follow the erection of smelting furnaces in India should make it remunerative, nor could it be reasonably expected. NICKEL has not been mined in India hitherto, possibly from the absence of any demand, for traces of the metal have been reported from Rajpootana and Khetre, though only as occurring in connection with other metals, such as copper and cobalt. It is, however, unlikely that the Indian iron industries will advance to the point of making nickel steel, at any rate for the present, though the iron ore in Salem and elsewhere is so good that there are no limits to the possible development of the metal. With magnificent ore and fine charcoal, only science and skill are required to produce the very finest results.

CHROMIUM, so useful in the manufacture of chrome steel, is found in the form of chromite in the Salem district. The Porto-Novo Company started in 1833 was called the "Indian Steel, Iron, and Chrome Company," and opened a chromite mine at Curpur, from which ore was exported to England. It is stated in Ball's Economic Geology that "the principal rock in the low hills at the south-west base of the Shevaroy Hills, where the mines are situated, are hornblende, mica, and talcose schists penetrated by dykes of basalt and layers of serpentine, which last is intersected by a perfect network of veins of magnesite. The

chromite occurs very irregularly in these veins in lenticular masses of various shapes and sizes; one block was said to weigh a couple of tons. At a depth of from 50 to 60 feet water became troublesome in the mines. It is not surprising, therefore, that mining became too expensive to be continued with profit, there being no certainty as to the proportion which the chromite bore to the mass of rock which had to be removed. At the same time the demand for this ore was by no means unlimited, and the immediate effect of throwing the Indian ore on the London market is stated to have been to cause a fall in price." The truth is that all the materials required for a successful iron industry are to be found in India, and only the energy to develop them is wanted. The failure of the feeble attempts that have been made from time to time to develop the iron ores seems to have been accepted as proof that they are not worth working. No other reasonable explanation for the supineness of capitalists in this direction seems forthcoming. The power of India will grow with her iron, as without it the resources of the country can never be fully developed.

CHAPTER VI.

FUEL.

The chief difficulty in the way of the development of Indian ores lies, as has already been suggested, in the question of fuel. If fuel suitable for smelting could be found conveniently near the deposits of ore, or if it could be transported at remunerative prices, the matter would be far simpler. The Bengal iron fields have the advantage of the Raniganj coal mines, from one of which, Sanctoria, very fair smelting coke can be made. Its analysis shows over 84 per cent. of carbon, and though 15 per cent. of ash is high, yet the actual impurities are low, sulphur being present to the extent of only a quarter per cent., and phosphorus being practically absent. No other iron field has such advantages in the way of coke, but fuel of sorts is nearly always obtainable at a reasonable cost, and every effort should be made to improve its quality where it is inferior. In a former chapter it was pointed out that the best coal for smelting purposes was found in Raniganj and the Wardha Valley. It may be said roughly that coal should contain at least sixty per cent. of carbon to give good result, and though the Raniganj coal generally is said to contain only some 53 per cent. of carbon on an average, yet the yield of the Kahabari (Hazaribagh) seam runs as high as 78 per cent., while the Pisgaon (Wardha Valley) coal gives an average of 65 per cent. In considering the value of coal for smelting, we must, however, not merely

consider its proportion of carbon when dug out of the ground, but its readiness to coke and the percentage of carbon likely to be found in the coke. This especially affects the coal found in the Madras Presidency. Thus the coal found at Beddadanol in the Godaveri Valley showed only 37 per cent. each of carbon and volatile gases, and 26 per cent. of ash, but on coking the volatile gases disappeared, leaving 60 per cent. of carbon and 40 per cent. of ash, thus just bringing the coal within the limits I have laid down as remunerative, though I admit that in this instance the ash is excessive. This would not prevent smelting, however, though it would possibly increase the labour of cleaning out the furnaces, if the ash clinkered instead of proving friable, and would certainly require care in tapping the charge into the pigs. Even if a little ash found its way into the pigs at first, that need not seriously interfere with their value, as it could be eliminated in subsequent castings. The Singareni coal shows from 62 to 66 per cent. of carbon, 23 per cent. of volatile gases, and from 11 to 15 per cent. of ash. Assuming that on coking the Singareni coal will act in a manner similar to that of Beddadanol, *viz.*, that all the volatile gases will disappear, and the carbon and ash be increased in the proportion of 23 to 14, we have a result for the poorest yield of 76 per cent. of carbon in the coke, and 24 per cent. of ash; this is quite good enough to work on, and may be taken as a fair basis for work with the products of this valley. Although the average of Raniganj coal gives only 53 per cent. of carbon, yet there is no reason why excellent smelting should not be done with it, for it contains over 30 per cent. of volatile gases (including moisture), and as this should all disappear in coking, the resultant coke should show 72 per cent. of carbon to 28 per cent. of ash.

The Barakur coal should give even better results, for it has 65 per cent. of carbon in its natural state, which would rise to over 79 per cent. when coked, the balance being ash. It is thus evident that the small proportion of carbon in the original Indian coals is not so serious a matter as might be supposed, on account of the high percentage of volatile gases which would disappear in coking. The effect on the Kahabari coal, which I have already shown is naturally the best for smelting, is to raise the carbon in the coke to from 80 to 84 per cent., while Warora coal, which, with only 45 per cent. of carbon, appears at first sight unsuitable, contains so much volatile gases and water (40 per cent.) that its coke would contain fully 70 per cent. of carbon.

Specimens of coal sent from Kanigorum (in the Waziri Hills) showed about 48 per cent. each of carbon volatile matter, and only 2 per cent. of ash. This if coked would yield 78 per cent. of carbon, but would so greatly increase the ash that it is doubtful whether in this instance it would not be better to use the coal as it stood with a hot blast. Kanigorum coal would not be of much use in iron working, on account of the enormous cost of transport, and the figures given being only from small samples, are not, perhaps, good indications of the general value of the coal there. This case is mentioned, however, to show that even inferior coal may be worked up into serviceable fuel, and may also be found in the most out-of-the-way and unexpected places. I have assumed that the coal would be coked before using to show how even apparently poor fields could be profitably worked. Such coal as that of Kahabari and Singareni would not, however, require such treatment; the proposal is only an alternative one in any case. In all probability it would pay better to artificially

increase the proportion of carbon, and this could be done by adding a certain amount of charcoal to each charge. Charcoal is by far the best fuel for iron-smelting, and if it could be obtained cheaply, it might be advantageously used at every stage. It is to charcoal that Indian iron must look for its future development, if for no other reason, because the purity and excellence of ore, and in cheap charcoal we must look for the means of starting a great industry. It may mean that each process will be a step in advance of those carried out in Europe, *viz.*, that coal processes have to be carried out with coke, and coke processes with charcoal, but the result will be good. Salem alone seems absolutely devoid of coal, and Salem ore is so good that it would pay to take it to Calcutta and smelt it with Kahabari coal. In fact, the value of fuel within a reasonable distance though all important for most ores becomes less when the quality rises to a very high grade. At the same time, good fuel, within reasonable distance, would be essential to the full development of the Salem fields, for the ore is far from being the same throughout, varying greatly, and only the best would be worth exporting to Bengal—if that. I am, therefore, compelled to consider the practicability of the use of charcoal throughout all the processes.

The Indian Steel, Iron, Chrome Company successfully used charcoal during 1833 and succeeding years, and if liberal forest rights were granted by Government, there is no reason why it should not be successfully used again. Good *babool* timber fit for charcoal would take about five years or less to arrive at a suitable size. *Babool* is one of the best, if not the best, firewood obtainable, as it is dense, and gives out great heat. Local timber and junglewoods would, however, probably, pay better in the end. The question of mixing charcoal with the coal, thereby raising

the percentage of carbon, is one worthy of consideration, though better results would probably be obtained if the charcoal was pounded and then pressed into bricks or slabs, so that its consistency might more closely resemble that of coal. The caking of powdered fuels is not studied as it might be, though it might lead to great results, especially in India. Another fuel that has been hitherto passed over is peat, of which a great deal is available in the Neilgherries. Dr. Percy, in his "Metallurgy," states that it is similar to the peat sold in England, while it is said to be procurable at the bog for eight annas per thousand pounds. It contains, however, a very large proportion of ash, and would, probably, require to be pulverized and mixed with charcoal dust to raise the percentage of carbon, and pressed into cakes. If this was done locally it would be economically used as fuel. Petroleum, unfortunately, has not yet been discovered in Southern India in any quantities, so that it would have to be imported if used as a lubricant in pressing cakes of charcoal dust, or charcoal dust and peat, but the cruder and cheaper forms of petroleum would be of great value in this connection. The whole question of artificial fuel is one that requires more technical treatment than I feel in a position to give it, but it is certainly worth the serious consideration of experts in connection with the development of the many ores that lie unworked beneath the surface of India. It would be necessary for such experts to fully satisfy themselves as to what really was available in the way of fuel in the different metal-bearing districts of India, and then to see how this material could be best worked up and used in smelting ores. Into the question of fuel in Burmah I have not gone. It is a subject upon which we require much more information than we have at present before

anyone can feel in a position to do the matter justice. Burmah will, I believe, prove to be rich in iron and coal, both appearing in the Chindwin Valley, for instance, in quantities that to the eye of anyone not an expert would appear conclusive proof that both could be remuneratively worked. Scientific and systematic examination is, however, necessary before the exact value of these fields can be determined. Arakan has long been known for a coal-bearing country, but its field yields material too poor in carbon for iron smelting, while in the Tenasserim division there are fairly good chances that the Hienlat mines would prove productive at a cost of some Rs. 16 a ton. It is in Upper Burmah, however, that the rich coal-fields are supposed to lie, that at Membaloung, in the Shan States, having been declared equal to the best English coal.

CHAPTER VII.

THE ADVANTAGES AND DISADVANTAGES OF INDIAN WORKMEN.

In considering the condition of Indian manufactures, and comparing it with that of other countries, one of the most striking points is the difference between Indian workmen and those of other nations, especially Europeans. These differences form, in some respects their strength and in other respects their weakness, and the question as to how to improve those qualities in which they are inferior and make the most of those in which they excel is one of the most serious that presents itself to the large employers of labour, to whom slight differences may matter a great deal pecuniarily, or to the statesman who is interested in the advance of Indian industries. One great difference has recently been brought somewhat vividly before us by the far from disinterested agitation recently set on foot at home about an Indian Factory Act and the long hours that labourers work out here. We might just as well ask the English Government to prohibit the workmen at home from putting out all their strength, and to bind them down to do no more in an hour than an English workman. An English collier will get out twice as much coal from a mine in an hour as an ordinary native cooly can manage in twice that time. Should we, therefore, demand that each man's production should be limited

to the output of an Indian cooly? Or should we rather try and induce our men to work up to the higher standard? Again we see a native who is set to pick up a pile of stones on the road side, or to remove a pile of mud, use a shovel at the far end of which is a string. The first man sticks the shovel in as far as it will easily go, then the cooly in front hauls on the string, and, together, they manage to bring up a small amount of coal sufficient to make a slight appearance of work done. An English "navigator," on the contrary, dispenses with all assistance, and shovels away great masses of earth as fast as he can work, doing an enormous amount of work a day. Similarly, an English carpenter uses a jack plane by himself, but a native mistry places a cross handle at the end and gets a boy to help him by pulling. This is all very well in its way, but are we to demand that the navvy and the carpenter are to keep their quantum of work down to that of the cooly and mistry? The fallacy of such an idea would be at once condemned by all sensible men as being utterly destructive to trade, and the proposer would be told, with perfect truth and considerable warmth, to go elsewhere and learn a little political economy, and yet the one proposal is as sensible as the other. If the English workman finds that his strength is over-taxed he will either strike or agitate for legislation. Similarly the Indian labourer can look after himself. The old idea of "silent suffering India" is exploded now, at least as far as the artizan class is concerned, for they can speak for themselves, and find Englishmen to speak for them. Their own leaders do not seem to care much about them, but, after all, we know very little what the leaders of the people really do care about.

Among other advantages which the native workman possesses, we may class his low expense for food and cloth-

ing, partly due to the climate but chiefly to long inherited habits of thrift and self-denial, which render it absolutely necessary for him to live on the cheapest and smallest possible quantity of food. This power of living cheaply and yet healthily greatly adds to the producing power of the country, in that it leaves a greater margin to work on. Where the necessities of life are less, as they are in India, the result is a distinct gain to the country. For instance, a workman has to give, in England, from half a crown to three and sixpence a week for a room, or about eight rupees a month, and nearly a shilling a day, or say, fifteen rupees a month for his food, while the Indian workman pays only one or two rupees monthly for his hut, and some five or six rupees for his food.

This shows a distinct gain of fifteen rupees a month per workman in the amount required to board and lodge him. Clothes, again, are far cheaper here than at home, on account of the climate, and this again tells in favour of the local products. Great as is the difference between the native of India and of England in the manner of living and working, the difference between the men in various parts of India is nearly as great. For instance, the blacksmiths of Bombay deservedly pride themselves on being the best in India, and their physique contrasts favourably with that of men in all other parts of India, as does their manner of working. A first class Bombay smith, trained under a good European foreman, will do nearly as much work as his companion at home, certainly more than the average, and he can both strike harder and work more skilfully than most of his fellows in this country. On the other hand, the number of these highly trained men is small for the requirements of the country, and their pay is high, a fact that undoubtedly tends to induce others to

qualify themselves in like manner, but the supply is not yet equal to the demand. In maritime pursuits, too, we find the lascar well able to hold his own with his rival, as was shown in the inquiry held some time ago into the wreck of the "Tasmania," in the course of which evidence was adduced to show that lascar crews were quite as reliable, even in cold climates, as the ordinary merchantman's crew of to-day: one reason of this is the superior temperance of the native, for though there has been an absurd outcry made against the abkari laws and the alleged tendency towards the encouragement of drunkenness, the fact remains that the natives of India, excluding the menial classes, are the soberest people in the world. This sobriety is a great pull to the workmen, for it not only makes them more reliable and less absent to stay away suddenly, but it greatly lessens their expenses and enables them to make better use of their money. In the keen struggle for business in the present day, when little facts influence large sums of money and gigantic interests, all these details are of the greatest importance, and make the difference between success and failure, that pie in the rupee, which means profit or loss.

There is another side to the picture, however, that is not so rosy, and that makes one all the more anxious that attempts should be made to improve the faults. In the first place the native workman is far too careless about the *finish* of his work. Though he will spend weeks and months in the elaboration of some ornamental work, in the fine chasing of a plate or the cover of a jewel-box, in devising and executing some mechanical toy, he will slur over and omit such details as the hinges and locks, his box won't close properly, and his mechanism often contains some one piece of work, either too rough or too weak for the strain put upon it, so that it breaks down in a short time. He is not suffi-

ciently careful of his work, but prefers easy methods even though they do not give such good results. Take the iron moulder's work, for instance ; the European moulder is never above taking infinite trouble to secure the success of his casting. He will set his pattern carefully in the sand, placing the necessary feeders so as to prevent any chance of the metal sinking, and will go about his work in a careful, methodical manner, and yet without any delay or waste of time, so that he gets through a good day's work without much chance of a failure. The native moulder, on the contrary, will always use loam moulds if he can, notwithstanding the fact that it is a much more expensive method of working than any other, and even when he works in sand will spend half an hour in patting it and putting on a number of finishing touches, which are quite unnecessary and fulfil no useful object, while he will forget very often to do some much more necessary detail, such as the true centering of his core or the steadying of his chaplets, so that the result is often a failure. He will not believe in the necessity for thoroughly venting and drying his mould, while he often pays but little attention to many other details. Of course, it may be argued that I am giving the worst side of the picture and that many men can be found who do not possess these failings. This is readily admitted ; but I am intentionally showing the seamy side, and, moreover, I have mentioned no fault that is not often committed by the ordinary workman, and to which even the good workman will not often recur when he is not watched and looked after carefully. It is this carelessness, this inattention to detail that is the great difficulty of the workmen of India, and the one failing with which they must struggle most earnestly. They appear, with comparatively few exceptions,

to be unable to realize that the value of anything beyond the very plainest work lies in its accuracy, and that accuracy must be real and not sham, thorough and not superficial. That it is useless to turn out a seemingly sound piece of iron-work with a good skin and to neglect the interior welding, so that it breaks at the least strain. An ornamental box that won't shut, or the hinges of which are so slight and weak that a moderately strong man can wrench off the top with his hands, is not a safe place for keeping anything in, nor is it foolish on the part of the master or the purchaser to insist upon these points being attended to. The revulsion from the old feeling of wonder at European skill is gone too far, and every workman now thinks he knows as much about his trade as anyone else. He will not readily accept hints, and he looks upon his superior's insistance on detail as being merely another proof that all Englishmen are crotchety, and only attends to such matters while he is under his master's eye. Let us, therefore, try and impress upon him that this is no trivial matter, that the future of some of our Indian industries depend upon their being attended to. There must be something wrong when iron castings are imported from Glasgow on the score of economy, and this will never be set right till the higher classes of natives, the native gentry, interest themselves personally in these matters. The workmen will believe them, and they ought to address themselves to this most important subject. The next few decades will be fraught with great results for Indian industries, and it rests with the people themselves whether these results shall be good or bad.

CHAPTER VIII.

ADVANTAGES AND DISADVANTAGES OF INDIAN WORKMEN—(*Continued*).

In the present state of trade all over the world, competition has brought profits down to the lowest possible level compatible with work being carried on at all, and every branch of trade has to do its utmost to reduce cost and to turn out serviceable articles at a rate that will command a ready market. At the present moment the great mass of work due to the extension of the city, &c., has prevented Bombay from feeling the general depression to any great extent in the trades actually engaged in these manufactures, but it will be necessary for our workmen to look carefully round if they hope to keep up the run of prosperity more than a few years. The workmen of India have many advantages as well as disadvantages when competing with those of other nations, and it is only by minimising the latter and increasing the former that they can hope to compete in Western industries with Western nations. One of their disadvantages is that, until lately, they have only been working for Indian consumption on articles that do not meet with much competition from without, and, consequently, have no experience of the way in which the necessity of competing with others forces them to keep the cost down to the lowest limit. Nor do they understand, to any great extent, the need for making things that people

want of the patterns that are most likely to sell, and for changing patterns at a moment's notice, if it is found that the one in existence is not liked. The patterns of most purely Indian articles are stereotyped for each province or district, and not only is there no demand for anything different, but there is a distinct dislike to use anything different. Consequently, the village workmen, and even those in large towns, are so accustomed to work incessantly at the few fixed types which find a ready sale, that they are unaccustomed to any variation and indisposed to carry them out. Unfortunately some of our firms in England suffer from the same defect in their administration, and Consular reports tell us of many places where British trade has either lost its hold, or not got a footing at all, simply because its representatives, instead of finding out what the people of the country want, and advising the home firms accordingly, trust to the mere erection of a store to create a demand for English goods among the people of the district. It is useless to expect any great extension of trade in new regions without pushing it among the people and sending agents hither and thither to exhibit their wares and ask for orders. In India we see a system of peddling pursued to the utmost extent in the matter of small articles of daily supply, but there is as yet no evidence that the commercial traveller, as such, is understood or appreciated at his true value. There are dozens of ingenious little aids to agriculture, &c., which materially save labour and are sold at an absurdly low price, which might be disposed of in quantities in the districts if they were only "carried around" and their use and value explained on the spot.

Another great disadvantage of the native workman is his slowness. Trained among a people whose ideas of time are in every way vague, who think nothing of spending months

over a single shawl or carpet, and provided they are not actually hungry, regard all else with disdain, it is impossible for them to grow up with a proper understanding of the value of time. Consequently, their work, though excellent and often reliable, is terribly slow, and the little advance often made in a considerable period is irritating in the extreme to the rapid European workmen. This slowness places the native at a very great disadvantage ; as a labourer is only worthy of pay in proportion to his labour, and as the native often does not get through more than a third of what a European could do in the same time, and, consequently, could not, in justice, expect more than one-third of the pay. As this is a matter that only requires a little application to remedy, I do not refer to those branches of industry which are practically fine arts, such as carving, inlaying, &c., or even to the finer branches of carpet weaving, as all these require time for their execution, and the characteristic beauties of Indian work are such as can only be properly brought out by long and patient labour. The ordinary manufactures, however, do not require this nicety, and very great improvement might be made in the rapidity with which these are produced. Take, for instance, the single item of castings, either brass or iron. A good English moulder will lay down thirty moulds in the time a native moulder will lay down a dozen, the quality of the work being equal. Allowing something for the superiority of English sand over that obtainable here, this still leaves a very large margin in favour of the European, a margin that can only be reduced by increased activity on the part of the Indian workman. And this activity could easily be displayed if the necessity for it was thoroughly appreciated by the men concerned. It is not any inferiority that keeps the native behindhand, but

a kind of apathy, a desire to get the necessary daily bread in the normal way, with the least possible bother, partly, also, ignorance and the fear that the increased labour might not bring any benefit to them personally. The only cure for this is a more liberal education and a thorough understanding of the necessities of trade. Of course deficient bodily strength is against the native in some things, but not in many, as all the higher kinds of manufacture do not involve any severe physical labour, so that we may omit this item in calculating his chances of success. His advantages are considerable, and he ought to make the most of them so as to set them off against his deficiencies. In the first place, being always sober, he is more reliable than the ordinary English workman, and he should see that this readiness for instant work at any time is carefully cultivated. He has also, and this is his grand advantage, the power of working sixteen hours a day without falling sick.

Independent workmen in big cities, who get paid for the results and not for the time, often labour from early dawn till midnight to get out jobs for which they will be well paid, and even to manufacture stock for sale. Look, for instance, at the small blacksmiths, and the coppersmiths—you will hardly find so industrious a people in the whole world—hammering away till all hours of the night, and having no thought of anything save ceaseless toil. Lucky is it for the workmen of India that they are not under the domination of Trades Unions, which insist that no man shall do more than a certain number of hours' work a day. . Trades Unions are very good things in their way, as a means of spreading a knowledge of economic facts among the men belonging to them, and giving strength where workmen are really oppressed. They make it impossible for a single employer of labour to avail himself of

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any natural advantages of position, &c., for the purpose of grinding down the pay of his employes below the normal level. They also help to prevent any extension of the "truck" system, than which nothing more harmful and pernicious can be imagined, and to force the employers to pay in coin, but they do a good deal of harm when they begin to dictate to their own people.

Take, for instance, the English glass trade, in the commoner grades of which England is being completely ousted by Germany, although, for the very best cut glass, the cream of the trade remains with the home manufacturers. The Germans have, however, nearly procured a monopoly of the trade in the commoner forms. To quote from one of the papers on the subject :—" English-made table-glass is still the very best, and fetches a higher price than the Continental goods ; but for the ordinary and common table goods the English manufacturer has no chance against his German adversary, for the workmen of the latter work for lower wages, for longer hours, and keep the plant fully employed, whilst the English glass-makers work only when they think they will, the furnaces and pots usually standing idle from one to two days out of the six. The workmen are the slaves of a Union, which will *only allow them to make, even if they wished otherwise, a certain quantity per week.*" This proves that the strain of German competition would be less if English workmen would or could work longer hours. Indian workmen can and do work these hours, and they should keep hold of this advantage and allow no one to advise them to combine or in any way to influence them to their own evil. They are clever, intelligent and skilful, and if they keep firm hold of their sobriety and long hours and increase their working speed as much as possible, they will win in the struggle yet.

CHAPTER IX.

ARTIZAN *versus* CLERK.

A certain amount of attention has recently been drawn to the reckless manner in which artizans in good work bring up their sons to be clerks instead of training them for the trade to which they were born, or to some other trade of a similar nature, and the disastrous results that such a course often brings about. "A Native Thinker," the *nom de plume* of an experienced native gentleman of high rank, now resident in Madras, mentions a case of a goldsmith's eldest son, who had received a collegiate education, and who, at the time of writing, was only able to earn twelve rupees a month by hard work as a copying clerk, and whose younger brothers were able to make thirty rupees a month at their trade with more leisure and less fatiguing work. Young India is now passing through a phase of existence that once was the bane of England, though now happily somewhat abating, *viz.*, that in which the career of a clerk, however humble, is considered superior to that of an artizan, so that lads who would turn up their noses at "trade" were ready enough to accept office stools at starvation salaries, and imagined their employment to be the more "gentlemanly," or, strictly speaking, the more "genteel" of the two. It may be more genteel, but it cannot be more gentlemanly, if we count either the character of the work or the intellect required for it, and the only explanation

I can give of this extraordinary idea is, that in some rare cases clerks have risen to very high positions, and that the sons of merchants and bankers, who always begin as clerks, may be destined to become partners in a few years. These facts, and the great spread of superficial education, have caused a confusion between the position of the lower and higher grades of clerks. There is no trade, except some of the very lowest, that requires less skill and training than that of a mere copying clerk, a man who has merely to know how to write, and has not even to write anything original, but either copies the writing of others or makes out a few short lines that are practically mere forms. Education is a grand thing in its way, but mere reading and writing should not be called education, even if it be in a foreign tongue, and that is all that is required for most of the billets that clerks of the lower grade are able to attain.

In addition to this, there is, in Young India, the idea that a clerkship is the only respectable work that a graduate can take up, provided, as is generally the case, he is not able to qualify for one of the learned professions ; and the spread of education among a certain class has led to the belief that the successful graduate should be entitled to a Government appointment ; in other words, that Government having given him an education as a means of earning a livelihood should then support him for the rest of his life. It is an old taunt in India that it lives under a "despotism of despatch boxes, tempered by the loss of the keys," and that it is "Babu-ruled," and the above fact shows that there is some amount of truth in the accusation. The necessity for copying clerks places a certain amount of patronage in the hands of the senior clerks, for the question of copying documents is so purely a matter of routine that it is seldom that a man becomes sufficiently important in that position

to attract the notice of anyone but the clerks above him and the matter is purely one of office routine. Clerks of position are thereby enabled to find positions for their relatives, which will at least keep them from starving, and may lead, if the lad happens to be intelligent and quick to learn, to a really good position. But if native lads could only realize how much better off they would be under the conditions of an artizan than of a lower grade clerk, they would not be so eager to resign the former position for the latter. It is a great pity that some of our more enlightened and better educated native gentlemen of position do not try and urge these facts on their countrymen, and point out the real pecuniary loss it is to an ordinary workman if he is educated for the office instead of the "bench."

I fear that in this, as in many other things, caste has much to answer for. A Brahmin can be a clerk, and most of the well-placed Hindoo clerks are either Brahmins or, at least, high caste men, and the artizan imagines that he is raising his son by educating him for a similar position, and then getting him a place as junior copyist in some office. But, unfortunately for them, the facts are quite otherwise, and those who could speak with authority on the matter are not willing enough to do so, under a mistaken idea that such a superficial education, though it may not be beneficial to the immediate recipient is of advantage to the people as a body, and tends to raise them. Indeed, the successful native gentlemen of culture are often, unconsciously, in themselves an argument against this view, for the lads point to this and that distinguished native lawyer or engineer or doctor or civilian and say, "he has made a brilliant success of life, why should not I also succeed?" Men—especially young men—do not like to acknowledge themselves to be fools or in any way inferior to

the best of the men around them, and consider they are quite able to do as well as the best. As a matter of fact, the men who have come to the front in the learned professions, are the pick of a large number of cases, and would have succeeded in any line of life. After all, the number of really educated natives is very small when compared with the millions in India, and the number of distinguished men, when judged by the same standard, is absolutely minute, though both seem more numerous than they really are, because of their prominence, either from their own success born of capacity or the failure of the many engendered by educated incapacity.

As a simple matter of fact, the intellect and skill required by an artizan is far higher than that required by a copying clerk, and, consequently, skilled labour is the higher calling of the two. Take the case of a goldsmith, for instance. A lad has first of all to learn the methods of melting gold and silver, of assaying them, and of calculating the percentages of alloy contained in various samples, as well as the various alloys most suitable to the different kinds of work. The old methods of working the pure metal only is giving way to the pressure of competition, and the native goldsmith now works in from 22-carat down to 9-carat metal, according to the price of the article and the nature of the work. In addition to this, he has to acquire the necessary skill—a question of years—and a knowledge of the best methods of making the various ornaments in ordinary use. He has also to acquire a knowledge of precious stones, and to be able to, at least, roughly estimate their value at sight, and no branch of the trade is more difficult than this, while in nothing is there so great a risk of loss from want of judgment. Most modern jewellers and goldsmiths, if they are at all pushing,

know something about watch-making and the construction of those ingenious mechanical toys which, when set in gold, take the fancy of the wealthiest section of native society. Even the smaller and comparatively simple of these, such as a gold snuff-box with a mechanical bird that springs up and sings a musical-box sort of tune when the lid is opened, represent a very large amount of skill and labour, while some of the largest and most elaborate pieces are triumphs of art in their way, and require the very highest skill. Compare such work as this with the work of an ordinary clerk in an office, and there cannot be a moment's hesitation as to which is the more difficult and, in many ways, the higher form of labour. I know how difficult it is to argue against the feelings of the Hindoo population especially, and to ask a high caste lad to take up work usually done by men of an inferior caste, even when such a trade contains nothing in itself likely to affect his caste in any way, is a question of time ; but I would at least urge that a beginning should be made where there is every chance of success, and that men who are already engaged in mechanical work should shrink from trying to educate their sons for the less paying, and distinctly less important, work done by a copying clerk, unless the lad shows some very marked signs of superiority, of which, by the way, a father is not always the best judge.

CHAPTER X

WORK AND WAGES.

THE tendency of all recently elevated trades and professions is to run for high wages quite irrespective of all other considerations bearing on their work, for they imagine, like children, that present profit to themselves is all that is required and to obtain that they will recklessly risk their whole future, just as the red Indians will slaughter a dozen wild buffaloes to make a feast of their tongues, and leave the rest of their bodies to the birds, perfectly regardless of the fact that such indiscriminate slaughter may prevent the possibility of their obtaining the necessary food at some future time; and just as it is difficult to persuade the red Indian that his careless destruction may result in the total loss of the herds on which he relies and that he may be driven to want because of his present thoughtlessness, so it is difficult to persuade the newly risen artizan that he can drain the well of commerce dry by overpumping, or that his wages must be regulated, not by a single town, but by the universal laws of supply and demand, which will cause his market to ebb away from him and his work to cease if he prices it at too high a figure. It is naturally very difficult to persuade a man that his work is being overpaid, for he merely imagines that his skill has increased and that there is a demand for his work that must be met at any cost. This is especially true of the native of India who for years has worked at an ex-

tremely small wage, and who, buoyed up on the crest of a wave of prosperity, forgets that he must secure his position if he does not want to have an ignominious fall. The idea of comparative wealth is so strange and yet so welcome to him that he cannot do anything but revel in it. The artizan in India has many things against him which do not press on his contemporary in England. Born of comparatively low caste he knows that no efforts of his can raise him out of the caste, that no amount of intelligence or study can ever improve his social position one bit as regards his Hindoo surroundings, and that any attempt to do so will only involve him in shame. He has this fact dinned into his ears day after day ; on the one hand, he hears regrets expressed that Rukhmibai is of the carpenter caste, as that fact precludes many Hindoos from sympathizing with her. An instance of this utter want of sympathy is said to have been shown when Babu Lal Mohun Ghose was a candidate for the borough of Holborn. It is reported that on one occasion, when he was declaiming on the rights of "the people" of India, a working man in the crowd, a cobbler by trade, called out "Why don't you bring a cobbler to speak, let us hear the Indian working man's views." Forgetting the part he was acting, forgetting all but his hereditary prejudices, he cried out, "What have I a thrice born Brahmin in common with a *chamar*?" As soon as he had said it, he saw what a mistake he had made, and regretted his haste, but that sentence cost him his seat, for it showed that it was not "the people" of India that he really had at heart, but only the upper class. Probably the incident was exaggerated, but it is founded on fact.

Having, therefore, nothing of the kind to look forward to, it is only natural that the Indian artizan should look

on the possession of comparative wealth as the *summum bonum* of life ; but it is for this very reason that the Bombay workmen should ponder earnestly and seriously on the fact that they are going too far in their desire for high wages and trades unionism, and that, if they do not take care to reduce the cost of labour within limits, the demand will pass away from them and they will see their trade gradually diminish till they have no work of any kind. Bombay is a shipping centre above everything, and, though we welcome the spread of manufactures in the city, yet, if they passed away to-morrow, they would not affect the prosperity of Bombay. It is as a port, and the natural gate of India from the West that our prosperity is assured, and on that far more than on any manufacturing reputation that the city relies for its greatness. And this very nearness to Europe and the facilities of carriage offered by the great shipping trade are in themselves powerful reasons why the Bombay artizans of all others should carefully proportion their demands to the hard logic of facts. Coal is very dear there, much dearer than it is in England or even in Bengal, and to compensate for that, wages must be kept at a low level, or the cost of the article produced will rise above the market price. This has already happened in one trade at least, that of the iron founders ; and it is a proof of the danger to which we refer that cast iron pillars and mouldings for building purposes should be imported from Glasgow, rather than be made in Bombay. Moulding and iron foundry work is of a kind that is available to artizans, being against the caste of none, and it is work that pays in England and Scotland and ought to pay in India. The material is readily obtainable at little or no cost, for pig iron makes excellent ballast, and the work of moulding is well suited to Indian habits, but the price of

coal is against Bombay, and the workmen refuse to meet it by accepting lower wages until such time as country coal is available at lower rates. One obstacle to this is the self-sufficiency of the Indian workman, who imagines that his trade customs, which suited the needs of the country two hundred years ago, are equal to the requirements of modern civilization, and that the innovations of European managers are mere foolishness, and of no real importance. The Indian workman can do as good work as the English if he will only try and if he has plenty of time, but his great fault is that he won't try, and thinks that an article sufficiently good to "do" is all that is required, and that, if the result of his labour will do the work required, though imperfectly, all extra finish and neatness of work is merely a foolish waste of labour. Nor will the wants of the present day wait for the slow progress of the old-fashioned Indian artizan, and the greatest advancement that hand labour has made in the last few decades is the increased pace at which results are obtained. Where a native moulder will make ten moulds his British contemporary will make from twenty to thirty, and it is, therefore, evident that, apart from all other considerations, and supposing the work of the two men to be equal, the Indian labourer is not worth much more than a third of the labour of the Briton, until he increases his skill and with it the pace at which he can work.

The danger does not exist so much in the trades which are the complements of the shipping trade, such as cotton-pressing, cart-building, &c., because the profit on cotton sales is sufficient to admit of large prices, while the trades that wait on the ships themselves, if not overrun, will always find enough work, from the mere fact that the work required in minor repairs to these vessels must be done on

the spot, and cannot be compensated for by any imported work. And this same idea is at present inflating the masons and builders with the idea that they can command what wages they like, and in consequence of which they show off their airs, and consider themselves indispensable. Of course, the mere fact that buildings must be made on the spot and cannot be imported ready-built is always in favour of that class of artizan, and the great extensions in the building line which are pending in Bombay make it likely that wages will remain high for a considerable time. But we would point out to the masons and carpenters of this city that, if they drive wages up too high, they will expose themselves to another sort of danger, *viz.*, that of an immigration of labourers. News of this kind flies fast and far, and it is quite possible that, if the news went abroad that masons and carpenters in Bombay were at a premium, and were controlling the market, we might wake up one morning to find a shipload of Chinese labourers in our midst, who would gradually grow in number and make the native builders wish they had been wise in time. The Chinese are extremely hardworking and industrious, they are quite as skilful as the best native carpenters, and they live on very little. Wherever they have taken root in India they thrive (they have, for instance, completely monopolized the leather trade in Calcutta), and they are accustomed to such excessive competition in their own country that they would work for starvation wages sooner than not monopolize the work. Imagine the effect that a thousand Chinese carpenters and masons, eager for work at ten rupees a month, would have on the artizans of Bombay. A fall like that would be final, for the native artizans could not compete with them, and they would come, when once they had found a footing, as fast as work could be found

for them. At the present moment it is difficult to get workmen to erect new buildings where any skill is required, and those who are engaged are very independent; but what if a contractor could dismiss them and get as many more to-morrow, or what if some enterprising contractor, driven to despair, imported a shipload of foreigners? These are the great dangers of the present high rate of wages earned by artizans, especially in Bombay, against which they must be specially warned, *viz.*, that where the articles can be imported they will be so imported directly it pays to do so, and that where import of articles is impossible, as in the building trade, immigration may prove a deadly enemy to the artizans if they do not restrain their avarice. The first evil may be mitigated by greater technical skill, the latter can only be averted by patience and moderation.

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